

WHAT IS CLAIMED IS:

1. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a cutting pulse is output for
5 time T_1 to the high-frequency power source to stop
a supply of power to the glow-discharge apparatus, when
 $dV_r/dt - dV_f/dt$ increases over a first level, where V_f
and V_r are a traveling-wave voltage and a reflected-
wave voltage applied to the glow-discharge apparatus,
10 respectively; and arc discharge is determined to have
developed in the glow-discharge apparatus, when V_r/V_f
increases to a second level or a higher level within
a preset time T_0 after the supply of power to the
glow-discharge apparatus is stopped.

15 2. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a cutting pulse is output for
time T_1 to the high-frequency power source to stop
a supply of power to the glow-discharge apparatus, when
20 $dV_r/dt - dV_f/dt$ increases over a first level, where V_f
and V_r are a traveling-wave voltage and a reflected-
wave voltage applied to the glow-discharge apparatus,
respectively; arc discharge is determined to have
developed in the glow-discharge apparatus, when V_r/V_f
25 increases to a second level or a higher level within
a preset time T_0 after the supply of power to
the glow-discharge apparatus is stopped; and the supply

of power to the glow-discharge apparatus is further stopped for time T_1 after the arc discharge is detected.

3. A method of detecting arc discharge in
5 a glow-discharge apparatus that has a high-frequency power source, in which a cutting pulse is output for time T_1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when $dV_r/dt - dV_f/dt$ increases over a first level, where V_f
10 and V_r are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; and arc discharge is determined to have developed in the glow-discharge apparatus, when V_r/V_f increases to a second level or a higher level and V_f
15 becomes greater than $V_{fmax} \times 0.05$ within a preset time T_0 after the supply of power to the glow-discharge apparatus is stopped.

4. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power
20 source, in which a cutting pulse is output for time T_1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when $dV_r/dt - dV_f/dt$ increases over a first level, where V_f and V_r are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus,
25 respectively; arc discharge is determined to have developed in the glow-discharge apparatus, when V_r/V_f

increases to a second level or a higher level and V_f becomes greater than $V_{fmax} \times 0.05$ within a preset time T_o after the supply of power to the glow-discharge apparatus is stopped; and the supply of power to the glow-discharge apparatus is further stopped for time T_1 after the arc discharge is detected.

5 5. The method of detecting arc discharge, according to any one of claims 1 to 4, wherein the first level ranges from $V_{fmax} \times 0.05$ to $V_{fmax} \times 0.2$, the
10 second level ranges from 0.5 to 0.95.

6. The method of detecting arc discharge, according to any one of claims 1 to 4, wherein the arc discharge is determined to have developed when V_r/V_f remains at the second level or a higher level for time
15 T_2 or longer.

7. The method of detecting arc discharge, according to claim 6, wherein the first level ranges from $V_{fmax} \times 0.05$ to $V_{fmax} \times 0.2$, and the second level ranges from 0.5 to 0.95.

20 8. The method of detecting arc discharge, according to claims 1 to 4, wherein the preset time T_o is measured, starting at a trailing edge of the cutting pulse.

25 9. The method of detecting arc discharge, according to claim 6, wherein the preset time T_o is measured, starting at a trailing edge of the cutting pulse.

10. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a load to the glow-discharge
apparatus is determined to undergo impedance matching,
5 when V_r/V_f is at a third level or a lower level, where
 V_f and V_r are a traveling-wave voltage and a reflected-
wave voltage applied to the glow-discharge apparatus,
respectively; and arc discharge is determined to have
developed in the glow-discharge apparatus, when V_r/V_f
10 thereafter increases to a second level or a higher
level.

11. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a load to the glow-discharge
apparatus is determined to undergo impedance matching,
15 when V_r/V_f is at a third level or a lower level,
where V_f and V_r are a traveling-wave voltage and
a reflected-wave voltage applied to the glow-discharge
apparatus, respectively; arc discharge is determined to
have developed in the glow-discharge apparatus, when
20 V_r/V_f thereafter increases to a second level or
a higher level; and a supply of power to the high-
frequency power source is stopped for time T_1 after the
arc discharge is detected.

25 12. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a load to the glow-discharge

apparatus is determined to undergo impedance matching,
when V_r/V_f is at a third level or a lower level,
where V_f and V_r are a traveling-wave voltage and
a reflected-wave voltage applied to the glow-discharge
5 apparatus, respectively; and arc discharge is
determined to have developed in the glow-discharge
apparatus, when V_r/V_f thereafter increases to
a second level or a higher level and V_f is greater than
 $V_{fmax} \times 0.05$.

10 13. A method of detecting arc discharge in
a glow-discharge apparatus that has a high-frequency
power source, in which a load to the glow-discharge
apparatus is determined to undergo impedance matching,
when V_r/V_f is at a third level or a lower level,
15 where V_f and V_r are a traveling-wave voltage and
a reflected-wave voltage applied to the glow-discharge
apparatus, respectively; arc discharge is determined to
have developed in the glow-discharge apparatus, when
 V_r/V_f thereafter increases to a second level or
20 a higher level and V_f is greater than $V_{fmax} \times 0.05$;
and a supply of power to the high-frequency power
source is stopped for time T_1 after the arc discharge
is detected.

25 14. The method of detecting arc discharge,
according to any one of claims 10 to 13, wherein the
second level ranges from 0.5 to 0.95, and the third
level ranges from 0.05 to 0.5.

15. A high-frequency arc-discharge control apparatus comprising:

5 a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T_1 to the high-frequency power source when $dV_r/dt - dV_f/dt$ increases over a first level, where V_f and V_r are a traveling-wave voltage and
10 a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over
15 a second level within a preset time T_0 after the first cutting-pulse output unit outputs a cutting pulse.

16. A high-frequency arc-discharge control apparatus comprising:

20 a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T_1 to the high-frequency power source when $dV_r/dt - dV_f/dt$ increases over a first
25 level, where V_f and V_r are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over a second level within a preset time T_0 after the first cutting-pulse output unit outputs a cutting-pulse, and outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over a second level within a preset time T_0 after outputting the cutting pulse to the high-frequency power source.

17. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T_1 to the high-frequency power source when $dV_r/dt - dV_f/dt$ increases over a first level, where V_f and V_r are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over a second level and V_f becomes greater than $V_{fmax} \times 0.05$ within a preset time T_0 after the first cutting-pulse output unit outputs a cutting pulse.

18. A high-frequency arc-discharge control

apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

5 a first cutting-pulse output unit which outputs a cutting pulse for time T_1 to the high-frequency power source when $dV_r/dt - dV_f/dt$ increases over a first level, where V_f and V_r are a traveling-wave voltage and a reflected-wave voltage applied from the power meter,
10 respectively; and

 a second cutting-pulse output unit which outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over a second level and V_f becomes greater than $V_{fmax} \times 0.05$
15 within a preset time T_o after the first cutting-pulse output unit outputs a cutting-pulse, and outputs the cutting pulse again for time T_1 to the high-frequency power source when V_r/V_f increases over a second level and V_f becomes greater than $V_{fmax} \times 0.05$ within
20 a preset time T_o after outputting the cutting pulse to the high-frequency power source.

19. The high-frequency arc-discharge control apparatus according to any one of claims 15 to 18, wherein the first level ranges from $V_{fmax} \times 0.05$ to
25 $V_{fmax} \times 0.2$, the second level ranges from 0.5 to 0.95.

20. The high-frequency arc-discharge control apparatus according to any one of claims 15 to 18,

wherein the second cutting-pulse output unit determines that the arc discharge has developed, when V_r/V_f remains at the second level or a higher level for time T_2 or longer.

5 21. The high-frequency arc-discharge control apparatus according to claim 20, wherein the first level ranges from $V_{fmax} \cdot 0.05$ to $V_{fmax} \cdot 0.2$, and the second level ranges from 0.5 to 0.95.

10 22. The high-frequency arc-discharge control apparatus according to claims 15 to 18, wherein the preset time T_0 is measured, starting at a trailing edge of the cutting pulse.

15 23. The high-frequency arc-discharge control apparatus according to claim 20, wherein the preset time T_0 is measured, starting at a trailing edge of the cutting pulse.

24. A high-frequency arc-discharge control apparatus comprising:

20 a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

 a matching-storing unit which stores data representing that a load undergoes impedance matching, when V_r/V_f is at a third level or a lower level, where V_f and V_r are a traveling-wave voltage and
25 a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs
a cutting pulse to the high-frequency power source when
 V_r/V_f increases to a second level or a higher level
while the matching-storing unit is storing the data
representing that the load undergoes impedance
matching.

25. A high-frequency arc-discharge control
apparatus comprising:

a glow-discharge apparatus which receives power
from a high-frequency power source through a power
meter and an impedance-matching circuit;

a matching-storing unit which stores data
representing that a load undergoes impedance matching,
when V_r/V_f is at a third level or a lower level, where
 V_f and V_r are a traveling-wave voltage and a reflected-
wave voltage applied from the power meter,
respectively; and

a cutting-pulse output unit which outputs a
cutting pulse to the high-frequency power source when
 V_r/V_f increases to a second level or a higher level
while the matching-storing unit is storing the data
representing that the load undergoes impedance
matching, and outputs the cutting-pulse again for time
 T_1 to the high-frequency power source when V_r/V_f
increases to the second level or a higher level within
a preset time T_0 after the cutting pulse is output to
the high-frequency power source.

26. A high-frequency arc-discharge control apparatus comprising:

5 a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data representing that a load undergoes impedance matching, when V_r/V_f is at a third level or a lower level, where V_f and V_r are a traveling-wave voltage and
10 a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs a cutting pulse to the high-frequency power source when V_r/V_f increases to a second level or a higher
15 level and V_f becomes greater than $V_{fmax} \times 0.05$ while the matching-storing unit is storing the data representing that the load undergoes impedance matching.

27. A high-frequency arc-discharge control
20 apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data
25 representing that a load undergoes impedance matching, when V_r/V_f is at a third level or a lower level, where V_f and V_r are a traveling-wave voltage and

a reflected-wave voltage applied from the power meter,
respectively; and

5 a cutting-pulse output unit which outputs
a cutting pulse to the high-frequency power source when
Vr/Vf increases to a second level or a higher level and
Vf becomes greater than $V_{fmax} \times 0.05$ while the
matching-storing unit is storing the data representing
that the load undergoes impedance matching, and outputs
the cutting-pulse again for time T1 to the high-
10 frequency power source when Vr/Vf increases to the
second level or a higher level within a preset time To
after the cutting pulse is output to the high-frequency
power source.

15 28. The high-frequency arc-discharge control
apparatus according to any one of claims 24 to 27,
wherein the second level ranges from 0.5 to 0.95, and
the third level ranges from 0.05 to 0.5.